Four new Queensland species of *Solanum* L. allied to *S. ellipticum* R.Br. (Solanaceae)

A.R. Bean

Summary

Bean, A.R. (2014). Four new Queensland species of *Solanum* L. allied to *S. ellipticum* R.Br. (Solanaceae). ***Austrobaileya* 9(2): 216–228**. Four new species of the *Solanum ellipticum* species group are described, *viz. Solanum adoxum* A.R.Bean, *S. capitaneum* A.R.Bean, *S. prolatum* A.R.Bean and the new combination *S. chillagoense* (Domin) A.R.Bean. The phenetic relationships between these and other taxa of the *S. ellipticum* group are clarified by the results of a morphometric analysis, using 18 quantitative characters and 25 operational taxonomic units. The new taxa are illustrated and maps of their distributions provided as is a map of *S. ellipticum*. An identification key for all Queensland species of the *S. ellipticum* group is provided. *Solanum dianthophorum* Dunal is formally placed in synonymy with *S. ellipticum* R.Br.

Key Words: Solanaceae, *Solanum ellipticum*, *Solanum adoxum*, *Solanum capitaneum*, *Solanum chillagoense*, *Solanum prolatum*, Australia flora, Queensland flora, taxonomy, morphometrics, new species, identification key, conservation status

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Introduction

Solanum ellipticum R.Br. has long been regarded as a taxonomically challenging species, encompassing a broad range of morphological forms. Symon (1981: 193) referred to "the cluster of species in the *S. ellipticum* R.Br. complex". Bean (2004) included a key to 16 informal taxonomic species-groups occurring in Australia, based on the groupings of Whalen (1984). The *Solanum ellipticum* group (Group 27), which is endemic to Australia, is one of these. In this key, the *Solanum ellipticum* group was distinguished by having green to yellow non-juicy fruits larger than 12 mm diameter, monomorphic flowers, calyx prickles 10–200 per flower, leaves with stellate hairs, calyx not accrescent, leaves more or less entire, and finger hairs rarely present. Bean (2004) included ten species in the *Solanum ellipticum* group, including two new species (*S. crebrispinum* A.R.Bean, *S. senticosum* A.R.Bean). In a more recent paper devoted to the *Solanum ellipticum* group (Bean 2011), 13 species were enumerated, after the description of four new species, reinstatement of two species, and the exclusion of three species from the group membership.

The present paper is devoted to the taxonomy of *Solanum ellipticum sens. lat.* in tropical Queensland, the centre of diversity for the *S. ellipticum* group. A morphometric analysis of data for several species in this group has been carried out. Morphometric studies have proved useful in helping define species limits in *Solanum* (Alvarez *et al.* 2008; Strickland-Constable *et al.* 2010). In the current paper, a morphometric analysis, illustrated by a dendrogram and ordination plot, supports the recognition of four new species (*S. adoxum, S. capitaneum, S. chillagoense* and *S. prolatum*) in the *S. ellipticum* group.

An interactive key (Bean 2012- onwards), covering the *Solanum* species of eastern and northern Australia, is available on the DELTA website.

Materials and methods

This revision is based on an examination of herbarium specimens at BRI. Measurements of floral parts and fruits were made using

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material preserved in spirit, or reconstituted in boiling water. Terminology follows Bean (2004). The distribution maps were compiled using DIVA-GIS Version 7.5.0, using label data of specimens at BRI.

Specimens of *Solanum ellipticum sens. lat.* were arranged into groups (putative taxa), based on their overall morphology. A selection of the most complete specimens from each group was then used for detailed measurements, with the individual herbarium specimens being the Operational Taxonomic Units (OTUs).

The groups were labelled with an informal name that refers to the locality of at least some of the specimens, and the OTUs within each group were numbered, i.e. Newcastle 1, 2 & 3; Hughenden 1, 2, 3 & 4; Chillagoe 1, 2 & 3; Ravenswood 1 & 2 and Edgbaston 1 & 2. Also included in the analysis were three samples of *S. ellipticum sens. str.*, two of *S. callosum* A.R.Bean, three of *S. crebrispinum* (postulated to be the closest relative of 'Newcastle'), and three of *S. cleistogamum* Symon (a close relative of 'Edgbaston' and 'Ravenswood').

A morphometric analysis was performed to help elucidate the phenetic relationships between the OTUs, and to assist in defining taxa. The analysis was done using Patn software, Version 2.30 (Belbin 2004), using 18 quantitative characters (**Table 1**), and 25 OTUs. The characters chosen were considered to be potentially useful in separating putative taxa, and have proved useful in previous *Solanum* taxonomic studies e.g. Bean (2004), Strickland-Constable *et al.* (2010). The author aimed to make 10 measurements per character per OTU, but this was often not possible, for example when fewer than 10 structures were available for measurement, or the structure was absent altogether. The mean value for each set of measurements was then calculated for each OTU. The values for Character 1 were recalculated using a Log (base 10) transformation, and the values for Character 3 were recalculated using a square root transformation. This was done so that these characters did not dominate the analysis, because of their large values and large range of values (Belbin 2004). The final matrix was then imported into Patn.

A hierarchical classification, using Gower's metric association measure and flexible UPGMA was produced (**Fig. 1**) and *a priori* grouping was not invoked. The ordination analysis used semi-strong hybrid multidimensional scaling (SSH) to produce a three-dimensional and a two-dimensional plot of the phenetic distance between the OTUs (**Fig. 2**). Various numbers of groups were tried in preliminary analyses, but in the final analysis, eight groups were specified.

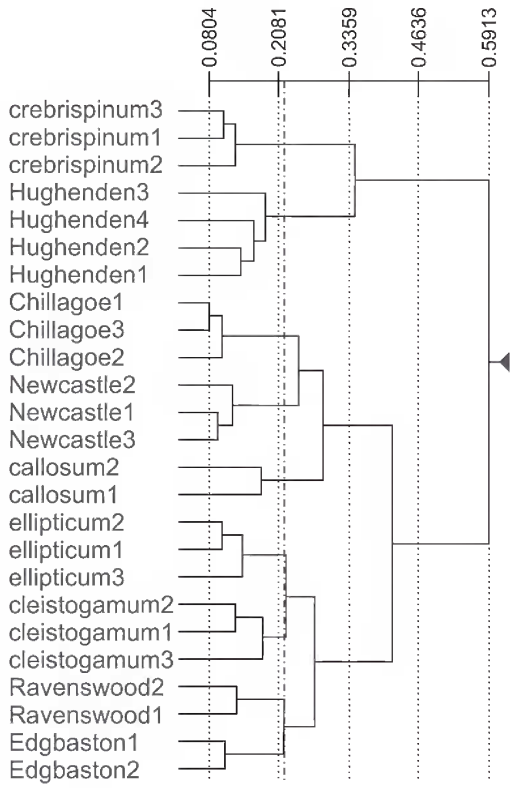

Fig. 1. UPGMA dendrogram generated from agglomerative group fusion using Gower's metric association measure.

Table 1. Characters used in the morphometric analysis.

The Kruskal-Wallis (KW) statistic cited for each character gives an indication of the value of each character, i.e. the higher the value, the greater is the utility of that character in discriminating between the groups.

	Character	KW value
1.	Leaf length (mm). The largest leaves on each specimen were measured	17.633
2.	Ratio between leaf length and leaf width, for the leaves measured in Character 1	16.428
3.	Prickles per cm of branchlet. Between two and four sections of branchlet were chosen for measurement on each specimen	22.341
4.	Number of stellate hairs per 0.25 mm^2 of the upper leaf surface. A hair was counted as present only if the attachment point was within the rectangular area measured	14.096
5.	Number of prickles on the upper leaf surface. Leaves were examined under the microscope as sometimes prickles are as short as 1 mm	19.059
6.	Stellate hair diameter (mm), upper leaf surface. Where multiple layers of hairs were present, only the uppermost hairs were measured	22.058
7.	Ratio of length of central ray to lateral rays of stellate hair (upper leaf surface)	15.345
8.	Longest stalk of stellate hair visible in the field of view (upper leaf surface	21.510
9.	Stellate hair diameter (mm), lower leaf surface. Where multiple layers of hairs were present, only the uppermost hairs were measured	21.267
10.	Ratio of length of central ray and lateral rays of stellate hair (lower leaf surface).	11.541
11.	Longest stalk of stellate hair visible in the field of view (lower leaf surface)	21.185
12.	Flower number per inflorescence. This measurement includes scars where flowers have abscised.	20.361
13.	13. Inflorescence rachis length (mm).	19.817
14.	14. Number of prickles on the calyx.	18.625
15.	Calyx lobe length at anthesis (mm). Only flowers at or very close to anthesis were measured, as calyx lobes lengthen as the bud/flower ages	16.177
16.	Corolla, ratio of apex length: sinus length. Large values indicate a deeply divided "stellate" corolla, while small values indicate a pentagonal or rotate corolla	17.585
17.	Fruiting pedicel length (mm)	11.285
18.	Peduncle length of basal fruit (mm). This is the distance from the base of the inflorescence to the first fruit attachment or scar	17.041

Results

The PATN analysis revealed eight or nine distinct taxon groupings in the UPGMA dendrogram (**Fig. 1**), and these are largely congruent with the putative taxon sorting originally made. When the data were analysed again using untransformed values for Characters 1 and 3, the same taxon groupings were obtained. Transforming the values for Characters 1 and 3 affected only the Ordination stress value, which was reduced from 0.0899 to 0.0825.

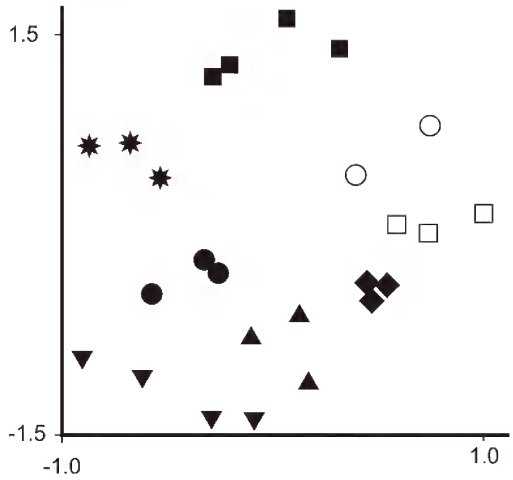

Fig. 2. Two dimensional ordination of the OTUs, using semi-strong hybrid multidimensional scaling (SSH). The minimum spanning tree is shown, with eight groups distinguished by different symbols.
▼ *S. adoxum*, ○ *S.callosum*, □ *S. capitaneum*,
◆ *S. chillagoense*, ✸ *S. crebrispinum*,
▲ *S. cleistogamum*, ● *S. ellipticum*, ■ *S. prolatum*.

Eight taxon groups are distinguished in a 2-dimensional ordination, with minimum spanning tree (**Fig. 2**). These groups are accepted here as taxa at species rank. Species rank is appropriate because each taxon differs from all its relatives by at least four characters, and because the phenetic differences between the putative new species are as great as or greater than the differences between established species e.g. *S. ellipticum* and *S. cleistogamum* (**Fig. 1**).

The 'Edgbaston' and 'Ravenswood' specimens were originally placed in separate groups, as the two 'Ravenswood' specimens differ from the two 'Edgbaston' in a number of characters, e.g. the broader leaves, the abundant glandular stellate hairs, the somewhat larger-diameter stellate hairs, and the numerous stellate hairs with a very long central ray. The differences are reflected by their strong separation on the dendrogram. However, I believe that these morphological differences are largely due to the juvenile nature of the available 'Ravenswood' specimens. The 'Edgbaston' specimens are from older, fully adult plants, lacking any juvenile growth or new shoots – they do also possess the distinctive indumentum characters mentioned above, but at very low frequencies, and their leaves are narrower.

Taxonomy

Solanum adoxum A.R.Bean **sp. nov.** affinis *S. cleistogamo* sed habitu erecto usque fuso, foliis angustioribus basibus cuneatis praeditis, corolla profunde lobata et praesentia in crescentia juvenili pilorum stellatorum glandibus apicalibus instructorum, differens. **Typus:** Queensland. Mitchell District: Near Measuring Spring, Edgbaston Reserve, NE of Aramac, 6 April 2012, *A.R. Bean 31650* (holo: BRI; iso: CANB).

Sprawling to erect, rhizomatous perennial shrub, 0.2–0.8 m high. Branchlets green to yellow; prickles 0–3 per cm, straight, acicular or broad-based, 1.5–6 mm long, 5–10 times longer than wide, with stellate hairs throughout lower part or glabrous; stellate hairs dense, 0.3–0.5 mm diameter, stalks 0–0.1 mm long; lateral rays 6–8, porrect; central ray 0.6–2 times as long as laterals, gland-tipped or not gland-tipped; gland-tipped finger hairs absent or present, type 2 hairs absent. Adult leaves elliptical, entire, 1.8–3.7 cm long, 0.6–1.2 cm wide, 2.9–4.1 times longer than broad; apex obtuse, base cuneate, oblique part 0–2 mm long, obliqueness index 0–6 percent; petioles 0.6–1.2 cm long, 23–43% length of lamina, prickles present or absent. Upper leaf surface green to grey; prickles absent; stellate hairs distributed throughout, protostellae absent, hair density sparse to dense, 0.1–0.4 mm apart, 0.3–0.7 mm across, stalks absent or to 0.1 mm long, lateral rays 7–8, porrect; central ray 0.5–1.0 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish to white or grey; prickles absent; stellate hairs sparse to very dense; 0.05–0.4 mm apart, 0.4–0.8 mm diameter, stalks absent or to 0.1 mm long; lateral rays 5–8, porrect; central ray 0.4–0.9 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 1–26 mm long; rachis 1–45 mm long, prickles present; 2–5-flowered, with all flowers

bisexual, 5-merous; pedicels at anthesis 7–9 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 1.5–2.5 mm long; calyx lobes at anthesis deltate, 1.2–2.1 mm long; calyx prickles 8–26 per flower, 1–3 mm long; calyx stellae dense to very dense, transparent to white or yellow, 0.25–0.5 mm across, stalks absent or to 0.05 mm long, lateral rays 4–8, central ray 0.7–4 times as long as laterals, gland-tipped or not gland-tipped, gland-tipped simple hairs present or absent, type 2 hairs absent. Corolla purple, 7–9 mm long, deeply lobed, inner surface glabrous; anthers 3.0–4.7 mm long; filaments 0.2–0.3 mm long; ovary glabrous or with type 2 hairs; functional style 5–6.5 mm long, protruding between anthers, glabrous or with type 2 hairs. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 1–3.5 mm long; mature fruits 1–4 per inflorescence, globose, *c.* 8 mm diameter, pedicels 11–21 mm long. Mature fruits not seen. Juvenile leaves ovate, 3.4–4.4 cm long, 1.4–2.5 cm wide, prickles absent; stellate hairs 0.45–0.55 mm diameter, some with eglandular central ray 4–11 times as long as laterals, others with glandular central ray 0.6–1 times as long as laterals, lateral rays also often glandular; gland-tipped simple hairs frequent, 0.1–0.2 mm long. **Fig. 3A–E.**

***Additional specimens examined*:** Queensland. Mitchell District: 93 km E of Muttaburra on stock route through Sumana Station, Apr 2011, *Thompson MUT446 & Edginton* (AD, BRI); Edgbaston, NE of Aramac, Apr 2014, *Fensham 6399* (BRI); Ravenswood Station, 20 km ENE of Aramac, May 2006, *Thompson MUT312 & Wilson* (BRI); Ravenswood Station, 20 km E of Aramac, Apr 2012, *Bean 31745* (BRI).

***Distribution and habitat*:** *Solanum adoxum* is known from three localities – Ravenswood Station; Edgbaston Reserve; and Sumana, E of Muttaburra (**Map 1**). At the latter two localities, it grows on weathered sand dunes in association with *Triodia longiceps* J.M.Black. At Ravenswood, it has been found in a cleared area, formerly Gidgee (*Acacia cambagei* R.T.Baker) woodland, on sandy soil.

***Phenology*:** Flowers and fruits have been recorded for April and May.

***Affinities*:** *Solanum adoxum* is allied to *S. cleistogamum*, but differs from it by the upright to sprawling habit (prostrate for *S. cleistogamum*), the narrower leaves with cuneate leaf bases; the deeply lobed corolla (rotate for *S. cleistogamum*); the glandular stellate hairs and gland-tipped simple hairs on pedicels and branchlets, at least on young growth and juvenile plants (no glandular hairs for *S. cleistogamum*), the presence of stellate hairs with a very long central ray (4–11 times the laterals), at least on young growth and juvenile plants (stellate hairs with a very long central ray absent for *S. cleistogamum*).

***Conservation status*:** *Solanum adoxum* is known from just three subpopulations. The Ravenswood subpopulation is very small and extinction at that site is predicted due to grazing pressure. The Edgbaston site is within a Bush Heritage reserve, and should be stable, but fewer than 100 plants are known there. About six plants were observed in the Sumana subpopulation (E.J. Thompson, *pers. comm.* 2014), and the site is on a stock route. A conservation status of **Endangered** is recommended (IUCN 2001). EN B1ab(ii,iv) + 2ab(ii,iv); C1.

***Etymology*:** From the Greek *adoxos*, meaning 'without glory' or 'obscure'. This refers to its rather straggly habit and the lack of ornamental features.

Solanum capitaneum A.R.Bean **sp. nov.** affinis *S. crebrispino* sed inflorescentiis 6–12-floris, aculeis brevioribus in ramulis, aculeis 4–22 in calyce (adversum 50–70 in *S. crebrispino*) et pilis stellatis sparsis usque moderate densis in pagina superiore foliorum, differens. **Typus:** Queensland. Cook District: 3.6 km by road from Forsayth towards Georgetown, 3 February 2006, *K.R. McDonald KRM4857* (holo: BRI; iso: BM).

Solanum sp. (Newcastle Range D.E. Symon 4907); Henderson (2002).

Sprawling to erect, rhizomatous perennial shrub, 0.2–0.3 m high. Branchlets yellow, rusty or brown; prickles 4–26 per cm, straight, acicular, 1–4 mm long, 7–11 times longer than wide, with stellate hairs throughout lower part; stellate hairs very dense, 1.1–1.4 mm diameter, stalks 0–0.3 mm long; lateral rays 6–8, porrect; central ray 1–1.5 times

as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate, entire, 8.6–13.6 cm long, 3.1–5.3 cm wide, 2.1–2.8 times longer than broad; apex obtuse or acute, base cuneate or obtuse, oblique part 3–8 mm long, obliqueness index 3–6 percent; petioles 1.6–3.4 cm long, 18–25% length of lamina, prickles present. Upper leaf surface green; prickles absent or present on midvein only, 0–4, straight, acicular, 2–3 mm long; stellate hairs distributed throughout, protostellae present, hair density sparse or moderate, 0.5–1 mm apart, 1–1.7 mm across, stalks absent or to 0.3 mm long, lateral rays 6–8, porrect; central ray 0.9–1.3 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish-white, white, or grey; prickles absent; stellate hair density moderate or dense; 0.25–0.4 mm apart, 1–1.7 mm diameter, stalks 0.1–0.6 mm long; lateral rays 6–8, porrect; central ray 0.6–1.1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose) or 2-branched; common peduncle 16–38 mm long; rachis 45–110 mm long, prickles present; 6–12-flowered, with all flowers bisexual, 5-merous; pedicels at anthesis 9–11 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 2–2.5 mm long; calyx lobes at anthesis attenuate, 1–4 mm long; calyx prickles 4–22 per flower, 1.5–4 mm long; calyx stellae very dense, white or transparent or brown or rusty, 1–1.2 mm across, stalks 0–0.3 mm long, lateral rays 5–7, central ray 0.9–1.5 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla purple, 13–15 mm long, rotate or shallowly lobed, inner surface glabrous; anthers 6–6.7 mm long; filaments 0.2–0.3 mm long; ovary with Type 2 hairs only; functional style 7.5–9 mm long, protruding between anthers, glabrous. Fruiting calyx lobes less than half length of mature fruit, prickles 2–3 mm long; mature fruits 3–6 per inflorescence, globular, *c.* 17 mm diameter, 2-locular; placenta stalked, anvil-shaped; interior moist but not juicy, pericarp 0.8–1.4 mm thick; pedicels 12–16 mm long. **Fig. 3F-J.**

***Additional specimens examined*: Queensland.** Cook District: Blackdown, 2.5 km WNW of Nundah Creek crossing, Nov 2000, *Ford AF2489* (BRI); Alma-den, undated, *Bick s.n.* (BRI [AQ332188]); 68.4 km by road W of Mt Surprise, Newcastle Range, Mar 2006, *McDonald KRM4929* (BRI); Agate Creek fossicking area, Apr 2006, *McDonald KRM5207* (BRI); Newcastle Range, near Georgetown, Jan 2001, *McDonald KRM700* (BRI); *c.* 32 km E of Georgetown, May 1967, *Symon 4904*, *4907* (AD, BRI, CANB, K, MO); Newcastle Range, Routh Gorge, Jan 1983, *Sankowsky 242 & Sankowsky* (BRI); 5.6 km along Agate Creek Road from junction at Forsayth, Apr 2006, *McDonald KRM5144* (BRI); 3 km W of Forsayth, Apr 2003, *Wannan 2808 & Graham* (BRI); *c.* 32 km E of Georgetown, May 1967, *Symon 4906* (AD, BRI, MO); 67.3 km by road from Mt Surprise, Newcastle Range, Apr 2006, *McDonald KRM5116* (BRI); Townley, S of Georgetown, Jul 2001, *Fensham 4565* (BRI); Bagstowe, Stuarts Spring Nature Refuge, *c.* 95 km S of Georgetown, May 2011, *Mathieson MTM1054* (BRI).

***Distribution and habitat*:** *Solanum capitaneum* is found mainly around Georgetown and Forsayth, with several records from the Newcastle Range. There is also an old record from Alma-den (**Map 1**). Most (if not all) records are from eucalypt woodland with sandy soil on granite substrate.

***Phenology*:** Flowers have been recorded from November to July; mature fruits from January to July.

***Affinities*:** *Solanum capitaneum* is distinguished within the *S. ellipticum* group by its large stellate hairs, well-spaced on the upper leaf surface, and the sometimes branched inflorescence bearing 6–12 flowers. It is close to *S. crebrispinum*, but differs by the prickles on the branchlets < 6 mm long (up to 11 mm long for *S. crebrispinum*), the narrower leaves, 2.1–2.8 times longer than wide (vs. 1.5–2.1 times for *S. crebrispinum*), the upper leaf surface with sparse to moderately dense stellate hairs (vs. dense for *S. crebrispinum*) on stalks no longer than 0.3 mm (stalks to 0.9 mm for *S. crebrispinum*); the absence of prickles on the lower leaf surface (present for *S. crebrispinum*); the 6–12-flowered inflorescences (3–5-flowered for *S. crebrispinum*); flowers on pedicels 9–11 mm long (4–6 mm long for *S. crebrispinum*); and the calyx prickles 4–22 per flower (50–70 per flower for *S. crebrispinum*).

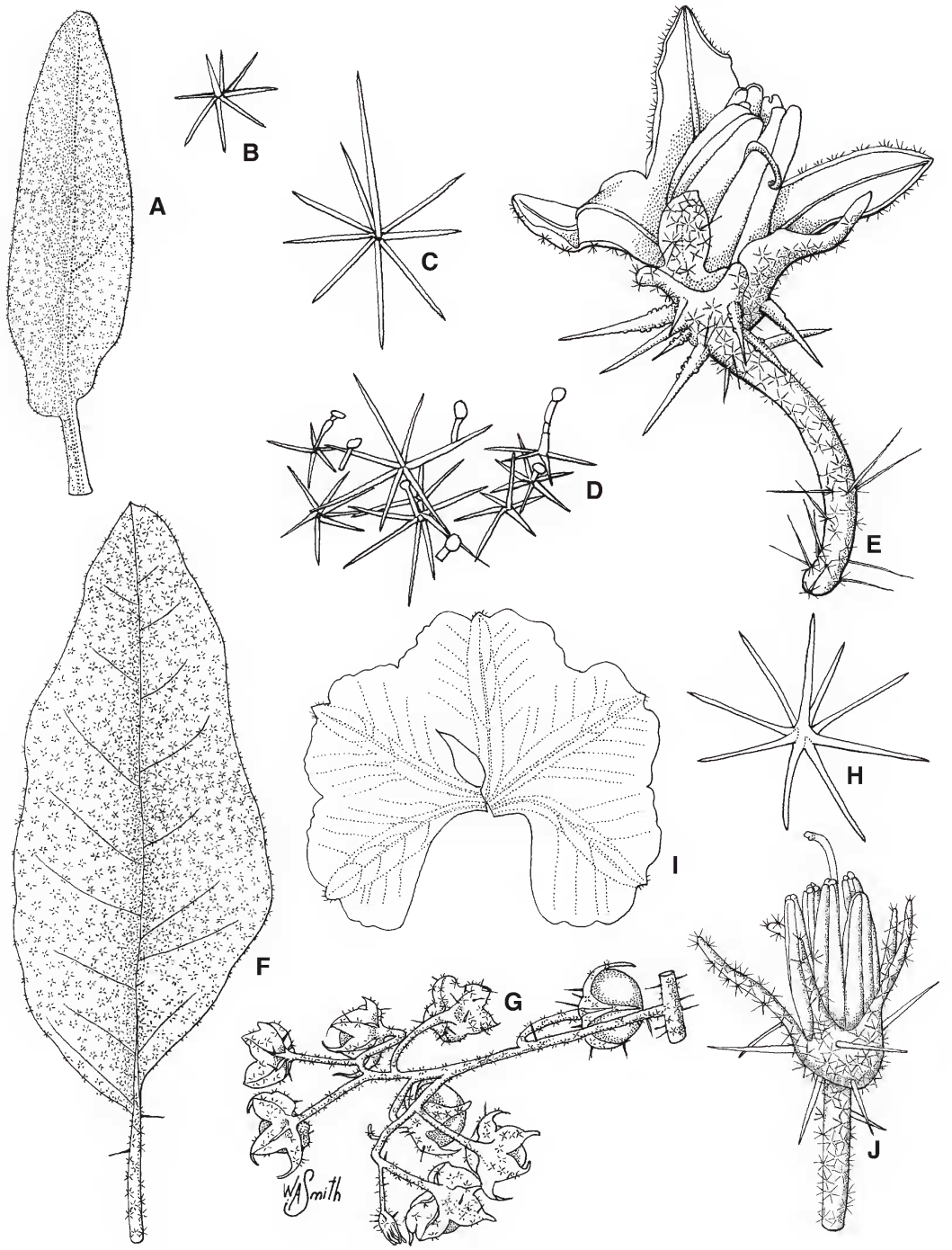

Fig. 3A–E: ***Solanum adoxum*** A. adult leaf ×2. B. stellate hair with short central ray ×48. C. stellate hair with long central ray ×48. D. branchlet indumentum with a mixture of stellate and simple glandular hairs ×48. E. flower at anthesis ×6. **F–J:** ***S. capitaneum***. F. adult leaf ×1. G. infructescence ×1. H. stellate hair from upper leaf surface ×24. I. corolla ×2. J. flower at anthesis with corolla removed ×3. A–B from *Bean 31650* (BRI); C–D from *Thompson MUT312 & Wilson* (BRI); E from *Bean 31745* (BRI); F–J from *McDonald KRM4857* (BRI). Del. W. Smith.

***Conservation status*:** Although the geographic range of *Solanum capitaneum* is not large, it appears to be relatively common within that range. A status of **Least Concern** (IUCN 2001) is recommended.

***Etymology*:** The epithet is from the Latin *capitaneus*, head or chief, and refers to the larger size of stellate hairs in this species in comparison to most species in the *S. ellipticum* group.

Solanum chillagoense (Domin) A.R.Bean **comb. et stat. nov.**; *S. ellipticum* var. *chillagoense* Domin, *Biblioth. Bot.* 89: 588 (1929). **Type:** Queensland. Cook District: near Chillagoe, February 1910, *K. Domin s.n.* [*Iter Australiense No. 8299*] (lecto [here designated]: PR 530913, photo at BRI).

Solanum ellipticum f. *albiflora* Domin, *Biblioth. Bot.* 89: 588 (1929). **Type:** Queensland. Cook District: near Chillagoe, February 1910, *K. Domin s.n.* (holo: ?PR), *n.v.*

Sprawling to prostrate, rhizomatous perennial shrub, 0.2–0.3 m high. Branchlets white, yellow or brown; prickles 1–9 per cm, straight, acicular, 1–8 mm long, 8–11 times longer than wide, with stellate hairs throughout lower part or sometimes glabrous; stellate hairs very dense, 0.6–0.8 mm diameter, stalks 0–0.2 mm long; lateral rays 7–8, porrect; central ray 0.4–1.1 times as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate, entire or obscurely lobed, 8.2–13.3 cm long, 3.4–4.6 cm wide, 2.2–2.9 times longer than broad; apex acuminate or acute, base cuneate, oblique part 2–7 mm long, obliqueness index 2–7 percent; petioles 2–3.5 cm long, 20–33% length of lamina, prickles present. Upper leaf surface green to grey-green; prickles absent or present on midvein only, 0–5, straight, acicular, 1–2 mm long; stellate hairs distributed throughout, protostellae absent, hair density moderate to dense, 0.25–0.35 mm apart, 0.6–0.8 mm across, stalks absent or to 0.15 mm long, lateral rays 7–9, porrect; central ray 0.4–1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish-white to white; prickles absent; stellate hairs dense; 0.15–0.3 mm apart, 0.6–0.8 mm diameter, stalks 0–0.3 mm long; lateral rays 7–8, porrect; central ray 0.5–1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 13–34 mm long; rachis 35–65 mm long, prickles present; 6–9-flowered, with some flowers bisexual and some male, 5-merous; pedicels at anthesis 7–11 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 2.5–3 mm long; calyx lobes at anthesis attenuate, 2.5–8 mm long; calyx prickles 6–21 per flower, 0.5–3.5 mm long; calyx stellae very dense, white or yellow, 0.5–0.7 mm across, stalks 0–0.3 mm long, lateral rays 8, central ray 0.8–1.1 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla mauve to purple, 8–10 mm long, deeply lobed, inner surface glabrous; anthers 3.5–4.5 mm long; filaments 0.3–0.8 mm long; ovary with stellate hairs only; functional style 6–9 mm long, protruding between anthers, glabrous or with stellate hairs near base. Fruiting calyx lobes less than half length of mature fruit, prickles 1–3.5 mm long; mature fruits 1–3 per inflorescence, oblate, *c.* 18 mm diameter, 2-locular; placenta stalked, anvil-shaped; interior moist but not juicy, pericarp 2.5–3 mm thick; pedicels 15–18 mm long. Seeds pale yellow, 2.3–2.5 mm long. **Fig. 4A–E.**

***Additional specimens examined*:** Queensland. Cook District: Chillagoe Caves NP, Royal Archway section, Mungana, Jan 2002, *Forster PIF28141 et al.* (BRI); Chillagoe – Mungana Road, *c.* 200 m SE of Red Dome turnoff, Nov 2000, *Ford AF2487* (BRI, NSW); 12 km S of Chillagoe, Burke Developmental Road, Dec 1991, *Gray 5370* (BRI, CNS); Dome Rock, E of Chillagoe, Mar 2000, *McDonald KRM317* (BRI); 11 miles [16.6 km] S of Chillagoe, May 1967, *Symon 4874* (BRI); 14 km SSE of Chillagoe beside Burke Developmental Road, May 2006, *Wannan 4385 & Gray* (AD, BRI, NY); SE of Chillagoe, Mar 2000, *McDonald KRM338* (BRI); Metal Hills [Chillagoe – Mungana Caves] NP, N of Chillagoe, Feb 2007, *Little & Little s.n.* (BRI [AQ728603]); Burke Developmental Road, *c.* 200 m SE of Red Dome turnoff, Mungana, May 2001, *Ford AF2793* (BRI, NSW); Royal Arch Cave, Chillagoe NP, Mar 2000, *McDonald KRM337* (BRI).

***Distribution and habitat*:** *Solanum chillagoense* is known only from the Chillagoe area of north Queensland (**Map 1**). All of the occurrences (except one) are associated with

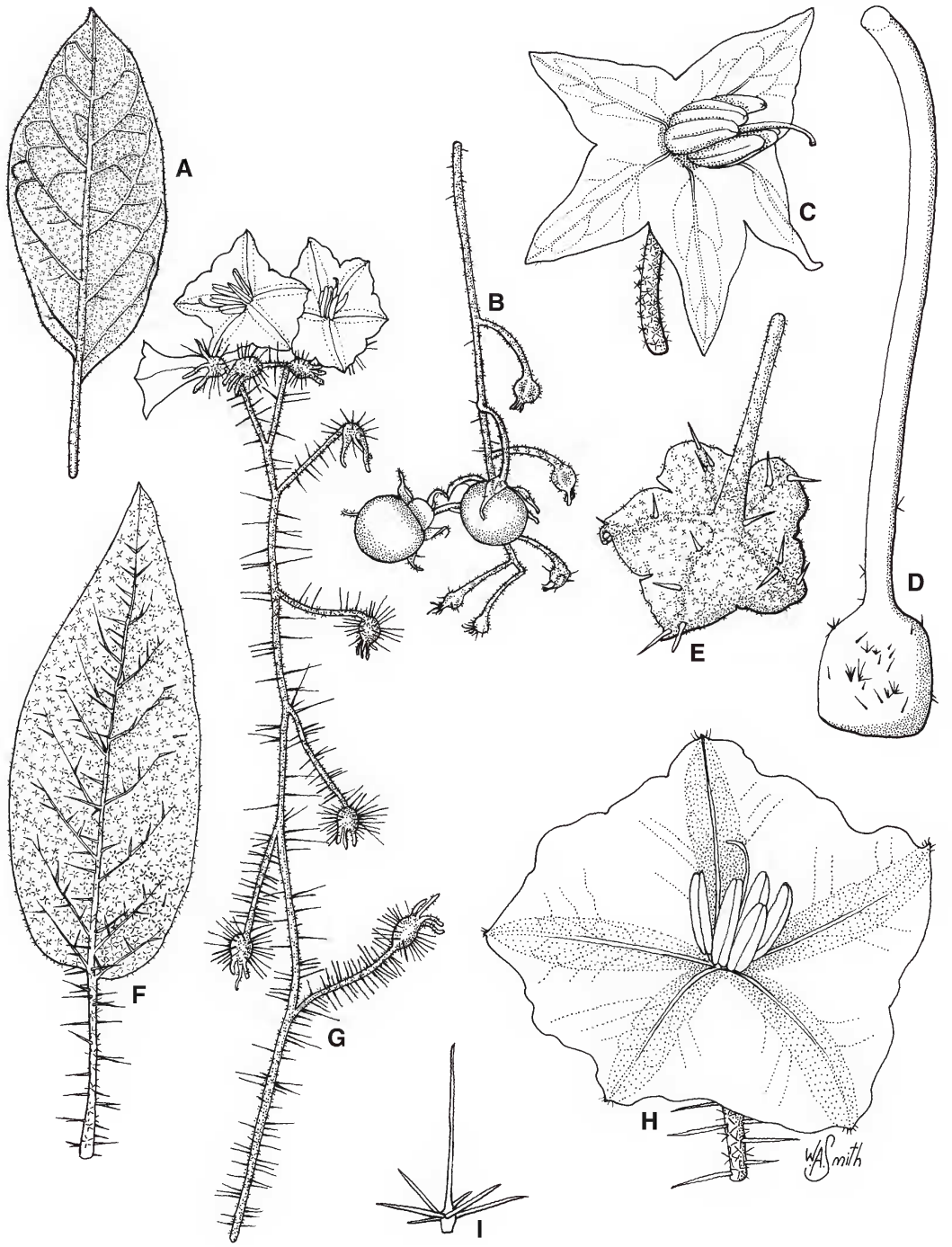

Fig. 4A–E: ***Solanum chillagoense***. A. adult leaf ×0.6. B. infructescence ×1. C. flower at anthesis ×3. D. style and ovary ×12. E. outer surface of fruiting calyx ×2. **F–I:** ***S. prolatum***. F. adult leaf ×0.6. G. inflorescence ×0.8. H. flower at anthesis ×2. I. stellate hair from upper leaf surface ×24. A–B from *McDonald KRM338* (BRI); C from *Forster PIF28141* (BRI); D–E from *McDonald KRM337* (BRI); F–H from *Cumming 23517* (BRI); I from *Johnson & Turpin s.n.* (BRI [AQ745940]). Del. W. Smith.

limestone karst, and several specimens are from semi-evergreen vine thicket.

***Phenology*:** Flowers have been recorded from November to May; mature fruits in May.

***Affinities*:** This species has been identified in the past as *Solanum ellipticum*. It differs from that species by the 6–9-flowered inflorescences (1–5-flowered for *S. ellipticum*), the distinctly oblate fruits (globose in *S. ellipticum*), the fruiting pericarp 2.5–3 mm thick (0.6–1 mm thick for *S. ellipticum*), the glabrous inner surface of the corolla (sparsely stellate-hairy for *S. ellipticum*), and the presence of dense stellate hairs on the ovary (glabrous or with Type 2 hairs for *S. ellipticum*). In addition, the calyx prickles on *S. chillagoense* occur only along the midribs.

***Conservation status*:** Although the geographic range of *Solanum chillagoense* is not large, it appears to be relatively common within that range. A status of **Least Concern** (IUCN 2001) is recommended.

Solanum prolatum A.R.Bean **sp. nov.** affinis *S. elliptico* sed aculeis multo magis in ramulis, aculeis 30–60 in pagina superiore foliorum, pilis stellatis in pagina superiore foliorum radio centrali radiis lateralibus 1.5–4 plo longiore praeditis, inflorescentiis 6–14-floris flores omnes bisexuales gerentibus et corolla rotata majore, differens. **Typus:** Queensland. Burke District: *c.* 4 km N of Solway Downs homestead, *c.* 90 km directly NW of Richmond, 14 November 1999, *D.C. Johnson & G.P. Turpin s.n.* (holo: BRI [AQ745940]).

Sprawling to prostrate, rhizomatous perennial shrub, up to 0.4 m high. Branchlets white, rusty or brown; prickles 24–98 per cm, straight, acicular, 2–8.5 mm long, 12–16 times longer than wide, glabrous; stellate hairs very dense, 0.7–1.1 mm diameter, stalks 0–0.5 mm long; lateral rays 7–8, porrect; central ray 0.8–1.3 times as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate to broadly ovate, entire or obscurely lobed, 6.3–11.4 cm long, 4–6.2 cm wide, 1.6–2.4 times longer than broad; apex obtuse or acute, base obtuse to cordate, oblique part 2.5–7 mm long, obliqueness index 3–6 percent; petioles 2.4–4.8 cm long, 30–44% length of lamina, prickles present. Upper leaf surface green to grey-green; prickles present on midvein and lateral veins, 30–60, straight, acicular, 2–7 mm long; stellate hairs distributed throughout, protostellae absent, hairs dense, 0.1–0.4 mm apart, 0.6–1 mm across, stalks 0–0.5 mm long, lateral rays 7–8, porrect or ascending; central ray 1.5–4 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface grey to white; prickles present on midvein and lateral veins, 13–23; stellate hairs dense to very dense, 0.1–0.25 mm apart, 0.8–1.2 mm diameter, stalks 0–1 mm long; lateral rays 7–8, porrect or ascending; central ray 1–2 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 22–43 mm long; rachis 36–82 mm long, prickles present; 6–14-flowered, all flowers bisexual, 5-merous; pedicels at anthesis 9–21 mm long, same thickness throughout, prickles present. Calyx tube at anthesis 1.5–3.5 mm long; calyx lobes at anthesis attenuate, 3.5–9 mm long; calyx prickles 36–82 per flower, 1–3.5 mm long; calyx stellae very dense, transparent or purplish, 0.7–1 mm across, stalks 0–0.5 mm long, lateral rays 6–8, central ray 2–3 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla purple, 16–18 mm long, rotate, inner surface glabrous; anthers 4.6–5.7 mm long; filaments 0.5–1.2 mm long; ovary glabrous; functional style 9–9.5 mm long, protruding between anthers, glabrous. Fruiting calyx lobes with prickles 2–3.5 mm long; pedicels 11–16 mm long. Mature fruits not seen. **Fig. 4F–I.**

***Additional specimens examined*:** Queensland. Burke District: Sussex Park, Flinders River, Jun 1934, *Blake 6258* (BRI); 16.8 km N of Kennedy Development Road near Hughenden towards Torver Valley, Aug 2005, *Cumming 23517* (AD, BRI). Mitchell District: 35 miles [58.2 km] S of Torrens Creek, Woura Park, Jun 1971, *Compton s.n.* (BRI [AQ039078]); Woura Park, 56 km S of Torrens Creek, Sep 1972, *Bode s.n.* (BRI [AQ005863]).

***Distribution and habitat*:** *Solanum prolatum* has a restricted distribution centred on the town of Hughenden (**Map 1**). At one location it occurs on the top of a breakaway with *Acacia cambagei*; at another it grows on a basalt slope

with *Corymbia dallachiana* (Benth.) K.D.Hill & L.A.S.Johnson and *C. terminalis* (F.Muell.) K.D.Hill & L.A.S.Johnson.

***Phenology*:** Flowers have been recorded between June and September. The fruiting period is unknown.

***Affinities*:** *Solanum prolatum* differs from *S. ellipticum* by the many more prickles on the branchlets, the obtuse to cordate leaf bases, the 30–60 prickles on the upper leaf surface (0–20 prickles for *S. ellipticum*), the stellate hairs on the upper leaf surface with a central ray 1.5–4 times the laterals (central ray 0.5–1 times for *S. ellipticum*), the 6–14 flowered inflorescences with all flowers bisexual (1–5 flowered with some flowers male for *S. ellipticum*), the corolla 16–18 mm long, rotate, glabrous on the inner surface (corolla 7–12 mm long, deeply to shallowly lobed, sparsely stellate hairy on inner surface for *S. ellipticum*).

***Conservation status*:** *Solanum prolatum* is known from just five specimens, but from quite a wide area. It is anticipated that more populations will be found, based on the availability of habitat. A status of **Data Deficient** (IUCN 2001) is therefore recommended.

***Etymology*:** From the Latin *prolatus*, meaning extended or elongated. This is in reference to the central ray of the stellate hairs, which is longer in this species than in any other of the *S. ellipticum* group.

Solanum ellipticum R.Br., *Prodr.* 446 (1810). **Type:** Queensland. Port Curtis District: Broadsound, 25 September 1802, *R. Brown* (lecto: BM, *fide* Symon [1981: 188]; isolecto: MPU).

Solanum dianthophorum Dunal, *Hist. Nat. Solanum* 183 (1813); *S. biflorum* R.Br., *nom. illeg., non* Lour. (1790), ***syn. nov.*** **Type:** Queensland. Port Curtis District: Port II, undated [Port Clinton, 21–23 August 1802], *R. Brown s.n.* [*Bennett number 2668*] (holo: BM).

For a description, see Bean (2011).

***Distribution and habitat*:** *Solanum ellipticum* is widespread in the eastern half of Queensland, excluding the far north and the high-rainfall areas of the south-east (**Map 2**). It grows on a diverse range of habitats and soils, where the drainage is good and high levels of sunlight are available.

***Notes*:** Bean (2004) accepted *Solanum dianthophorum* as a possibly distinct species, but restricted its use to the type specimen that was collected in what is now the Shoalwater Bay Training Area, north of Rockhampton. Recent biodiversity surveys there have resulted in the collection of several *Solanum ellipticum* specimens from a range of habitats. At least one of them was collected from littoral rainforest on sand near a beach. This is the presumed habitat of Brown's collection of *S. dianthophorum*, described by him as "arenosus prope littus". The absence of a distinct *S. dianthophorum*-like plant in that habitat (or any other habitat), combined with the presence of typical *S. ellipticum* there, has convinced me that the type of *S. dianthophorum* is merely an anomaly and that it should be reduced to synonymy with the widespread *S. ellipticum*.

Key to the Queensland species of the *Solanum ellipticum* group

1 Style eccentric, strongly bent near its base **2**
1. Style erect, sometimes curled near apex **3**

2 Branchlet hairs not floccose (stalks 0–0.2 mm); calyx prickles 0.5–2 mm long; corolla 9–13 mm long . . . . . **S. emmottii**
2. Branchlet hairs floccose (stalks 0–2 mm); calyx prickles 2–4 mm long; corolla 14–20 mm long . . . . . **S. lithophilum**

3 Inflorescences 1–5-flowered **4**
3. Inflorescences 6–12-flowered **10**

4 Calyx prickles more than 30 . . . . . **5**
4. Calyx prickles 0–30 . . . . . **7**

5 Branchlet prickles 0–10/cm; corolla inner surface sparsely hairy . . . . . **S. ellipticum**
5. Branchlet prickles 18–42/cm; corolla inner surface glabrous **6**

6 Leaves rusty-coloured, base cuneate; calyx stellate hairs 0.4–0.6 mm across; style and ovary glabrous; branchlet stellate hairs 0.6–0.9 mm diameter . . . . . **S. senticosum**
6. Leaves white to yellowish, base obtuse to cordate; calyx stellate hairs 0.7–0.9 mm across; style and ovary with short glandular hairs; branchlet stellate hairs 0.9–1.2 mm diameter . . . . . **S. crebrispinum**

7 Stellate hairs of upper leaf surface with a central ray 1.1–2 times longer than lateral rays; corolla rotate, white to mauve . . . . . **S. cleistogamum**
7. Stellate hairs of upper leaf surface with a central ray 0.5–1 times longer than lateral rays; corolla shallowly to deeply lobed, purple **8**

8 Adult leaves 0.7–1.2 cm wide, 2.9–4.1 times longer than broad, lower surface green; branchlets green. . . . . **S. adoxum**
8. Adult leaves 1.4–5.2 cm wide, 1.6–2.9 times longer than broad, lower surface greenish-white to grey; branchlets grey to brown **9**

9 Leaves 2.2–3.5 cm long, prickles absent from upper leaf surface; petioles 58–77% length of lamina; calyx prickles 0–4 . . . . . **S. unispinum**
9. Leaves 3.5–14 cm long, prickles 2–20 on upper leaf surface; petioles 20–45% length of lamina; calyx prickles (2–)5–30 . . . . . **S. ellipticum**

10 Stellate hairs of upper leaf surface with central ray 1.5–4 times longer than laterals; corolla 16–18 mm long, rotate . . . . . **S. prolatum**
10. Stellate hairs of upper leaf surface with central ray 0.4–1.3 times longer than laterals; corolla 8–15 mm long, deeply lobed or shallowly lobed. **11**

11 Stellate hairs of upper leaf surface 0.05–0.2 mm apart, centre to centre (dense to very dense) **12**
11. Stellate hairs of upper leaf surface 0.25–1.0 mm apart, centre to centre (sparse to dense). **13**

12 Stellate hairs consistently present on inner surface of corolla; rachis prickles present; branchlets terete; mature fruits 18–20 mm diameter . . . . **S. callosum**
12. Stellate hairs consistently absent from inner surface of corolla; rachis prickles absent; branchlets usually ridged; mature fruits 14–17 mm diameter . . . . . **S. quadriloculatum**

13 Stellate hairs of upper leaf surface 1–1.7 mm across, and 0.5–1 mm apart, centre to centre; all flowers bisexual; calyx prickles scattered; corolla 13–15 mm long, rotate or shallowly lobed; ovary with short glandular hairs only . . . . . **S. capitaneum**
13. Stellate hairs of upper leaf surface 0.6–0.8 mm across, and 0.25–0.35 mm apart, centre to centre; some flowers bisexual and some male; calyx prickles confined to midveins; corolla 8–10 mm long, deeply lobed; ovary with stellate hairs. . . . . **S. chillagoense**

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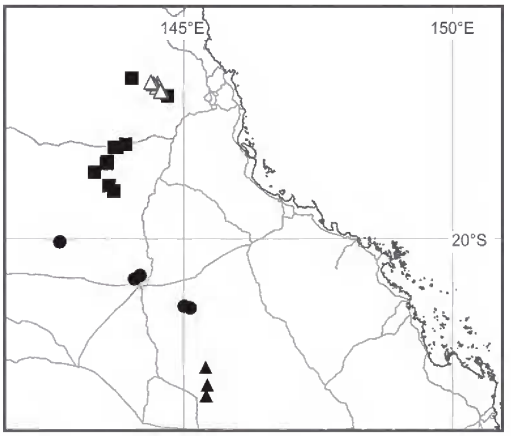
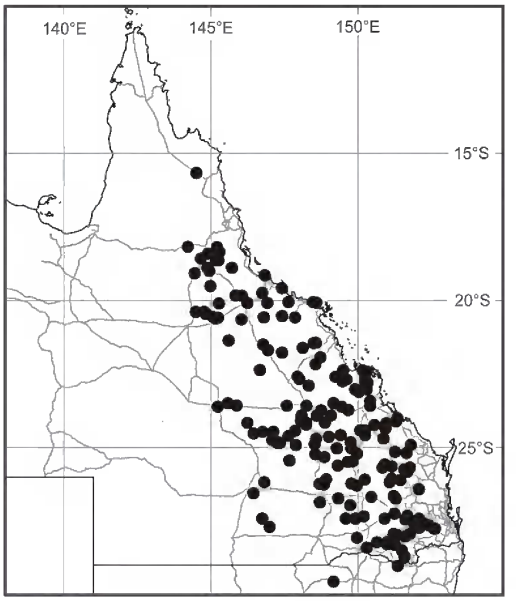


Map 1. Distribution of *Solanum adoxum* ▲, *S. capitaneum* ■, *S. chillagoense* △ and *S. prolatum* ● based on BRI specimens.



Map 2. Distribution of *Solanum ellipticum* based on BRI specimens.